BONNEVILLE POWER ADMINISTRATION

Pacific Ocean Shelf Tracking Project (POST)

Results from the Acoustic Tracking Study on Survival of Columbia River Salmon

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Pacific Ocean Shelf Tracking Project (POST):

Results from the Acoustic Tracking Study on
Survival of Columbia River Salmon

Annual Report

January 2004 – December 2004

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Description of 2004 Field Program for Columbia River Salmon

800 Snake River chinook smolts were implanted by Dr Carl Schreck's group at Oregon State University as part of an Army Corps of Engineers funded study in 2004. To reduce the costs of the demonstration study of the ocean array in 2004, we used these smolts to assess the utility of the ocean array to track Columbia River smolts. It had been intended that these smolts would be surgically implanted with tags using the full POST code map, which includes a transmission schedule that optimizes detection rates and tag lifespan. Unfortunately, the transmission schedule for the tags used in the OSU study was set at a 15 second interval rather than POST's 60 second transmission schedule, which reduced the rated life of the tags from approximately 4.5 months to about 30 days. This decision was made because of concerns that the Columbia River smolts would migrate rapidly out of the estuary, and thus would only be within range of the OSU receivers for short periods of time.

In the initial deployment of the array, BPA funding was used to place three partial listening lines across the open shelf at Cape Elisabeth (north of Grays Harbor, Wa.), Brooks Peninsula, (NW tip of Vancouver Island), and Cape Spencer, Alaska (north of Icy Strait). All of the equipment needed to form these listening lines was built to Kintama's specific design, and was placed in the ocean in April-May. The Cape Elisabeth line was deployed on 13 May 2004, the Brooks Peninsula Line was deployed May 1st, and the Alaska line was deployed June 8th. Additional lines were also deployed which covered the various entrances and exits from the Strait of Georgia ecosystem. As Columbia River smolts were not detected entering or leaving this part of the array, we do not comment further on the relevance for Columbia River smolts here, but the Chief Scientist's reports for September and October provide a detailed summary (See Appendices A & B).

Shortly after being deployed, we began receiving reports that units from the inner half of the Cape Elisabeth Line had broken free of the deployment and were being found on the beach. (The first report of a unit on the beach came in on 31 May). Although the exact date that the equipment broke free is uncertain, it is certain that once the units did break free they would float to the surface where the hydrophone would be oriented out of water, and unable to detect any tagged fish. A total of 6 of 12 deployed units broke free, all on the inner half of the line.

Executive Summary

During the 2004 field season, Kintama Research deployed a total of 137 acoustic receivers in a prototype demonstration array along the west coast of North America and conducted several R&D projects designed to facilitate the development of a permanent acoustic tracking array to measure movements and survival of Pacific salmon smolts at sea. As part of that project, acoustically tagged Snake River chinook smolts were tracked by the prototype acoustic array. These smolts were tagged by Dr Carl Schreck's group at Oregon State University after being barged down the river, tagged and released just below Bonneville Dam. Funding for Dr Schreck's project was provided by the Army Corps of Engineers, and although separate from the POST project goals, it had been agreed that it would be useful to use tags matching the specially chosen POST code map in 2004 so that these fish could be followed into the ocean.

Detection of Snake River smolts was poor, with only 4 smolts detected in the ocean. An analysis of the likely problems indicate that the poor detection was (1) caused by a mechanical failure of the inner half of the acoustic line nearest to the Columbia River mouth, preventing detection on the line just north of Grays Harbor, and (2) battery depletion of the tags prior to reaching the second line at Brooks Peninsula (N Vancouver Island). Both problems can be addressed in time for the 2005 field season.

Overall performance of the acoustic array for British Columbia smolts implanted by Kintama Research with tags using the full POST code map was excellent (and in contrast to the Columbia River results). A total of 1,051 smolts were tagged in British Columbia, and detection rates of the BC smolts over a single line was ca. 91%, and provided an essentially complete set of movements and survival data. In addition, the pilot array detected 25% of all acoustically tagged green sturgeon that had been released one year earlier in the Klamath, Rogue, and Sacramento rivers by other researchers. The detection of these fish demonstrates the utility of the array for addressing many resource issues at once, which will eventually distribute costs over a wider range of users.

Because of the good performance of the pilot-scale array deployed for these animals, we believe that the poor performance of the array for Columbia River smolts can be corrected. The data collected for the detected Snake River chinook does, however, indicate that they migrate at high rates of speed (23 kms/day) in shallow regions of the shelf close to shore. This is a particularly challenging environment in which to deploy acoustic tracking equipment because of high wave-induced movements during storms, and will require particular care in engineering the array to prevent mechanical failure.

Similar problems were also encountered with a few units reported breaking free from the Juan de Fuca Line in shallow water near both shores (but nowhere else). The problem causing the failure was identified when the acoustic lines were recovered in July, and was remedied by replacing the attachment to the groundline with a metal on metal connection that strengthened the attachment mechanism. The problem in all cases was restricted to shallow water regions where substantial water action caused the deployed units to sway back and forth in the bottom current and to cut through the original synthetic attachment mechanism.

As a result, the inner-half of the Cape Elisabeth line was absent for much of May and early June, until the line was picked up and re-deployed on 3 July. As chinook smolts are known to be distributed primarily in the shallower regions of the coast, the breach meant that the sub-array for monitoring movements along the Washington coast was not properly covered from sometime in mid to late May until the beginning of July. No Snake River smolts were detected on the outer half of the Cape Elisabeth line, which remained in place, but a large number of acoustically tagged green sturgeon were detected on the elements of this line that remained in place. This result indicates that the array can detect acoustically tagged fish if the array remains in place, and the absence of detections of green sturgeon on the inner part of this line indicates that most of these units probably broke free of the bottom soon after deployment.

Of the 800 smolts acoustically tagged and released at Bonneville Dam, only 4 Columbia River smolts were detected on the prototype array. One smolt was detected on the third receiver on the Cape Elisabeth (Grays Harbor) line on May 27th , and three were detected on the Brooks Peninsula line (on 5 & 27 June and 2 July). Two animals were detected on the 5th VR2, and one on the 8th (farthest offshore, nearest to the shelf break). None were detected entering the Strait of Georgia through the Strait of Juan de Fuca. (It should be noted that in the first deployment period, when the smolts were passing by, VR2s at positions 1, 3, and 4 were lost of the 8 deployed at Brooks Peninsula; in the second deployment period (July-September) all 8 units were recovered because of improvements we made).

According to Dr Schreck's group, between 40-50% of their 800 acoustically tagged smolts were known to have survived to the Columbia River mouth. Our data are too limited to provide a

clear answer as to whether it was poor ocean survival immediately after leaving the Columbia River mouth that accounted for the low number of tagged smolts that were subsequently detected, but the limited data collected does strongly suggest that Snake River chinook smolt movements are rapid, and that the smolts do not linger in the lower river or the Columbia River plume, but instead appear to move rapidly away from the river mouth. Our analysis below reports on the rate of movement of the Columbia River smolts that were detected, and shows that the lack of detection on the Brooks Peninsula line was almost certainly due to the tag programming causing a much shortened tag life.

Rate of Movement of Columbia River Chinook 2004

Mechanical failure of the inner half of the Cape Elisabeth (Grays Harbor) line may explain the poor detection of Snake River chinook smolts at this point, but does not explain why they were not detected on the Brooks Peninsula line, which remained largely intact. We therefore compared the expected time of arrival at Brooks Peninsula with the known lifespan of the tags for their programming schedule (ca. 30 days post-activation).

Mean distance traveled after release, based on the observed rates of movement.

day	km
15	337.5
25	562.5
30	675.0
31	697.5
35	787.5
50	1125.0
100	2250.1

Rate of movement (ROM) was based on the 3 chinook salmon smolts released downstream of the Bonneville Dam in the Columbia River (~225 km from the river mouth) and subsequently detected on the Brooks Peninsula acoustic receiver line (~740 km). One fish was released on 2 May, and detected on 5 June. Two fish were released on 27 May, and detected on 27 June and 2 July, respectively. The average ROM= .94 km/hr or 1.65 BL/s (body lengths/sec). These speeds translate into movements of 23 kms/day, but may be slightly overestimated due to initially rapid downstream migration from the release site to the lower Columbia River estuary.

Travel time from the Bonneville Dam to the lower estuary is approximately 4 days (Ben Clemens, personal communication[II]), which is considerably faster (2.3 km/hr, 4.3 BL/sec). The table and figures below show the approximate expected location along the migration route at

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different time intervals between 15 and 100 days after release assuming swimming at the average rate measured to Brooks Peninsula. (Note that these distances are extrapolated from the 2 known start/end positions.) We expect the smolts to reach the Cape Elizabeth line ~2 weeks after release, or possibly much faster since the river migration is swift.

Thirty days into the migration we would expect the fish to be in the vicinity of the region south of the Brooks Peninsula line. Based on the average swim speeds juvenile chinook should be north of the SE Alaska line north of Icy Strait ~100 days after release.

Transmitter Life

The average life of the transmitters (V8SC-6L with a 15 s pulse interval) implanted into Snake River chinook smolts in 2004 is 31 days based on the manufacture's battery specifications. Given an average rate of movement of 0.94 km/h, the transmitters would cease transmitting just south of Brooks Peninsula. The 3 fish detected at Brooks were at liberty for 33, 30, and 35 days before reaching the Peninsula, and the transmitters had been activated at some time prior to implantation. Clearly these transmitters were at the end of their life span, and unfortunately it appears that other Columbia River chinook probably reached the Brooks line but were not detected because of the frequent transmission schedule (15 sec pulse interval) and thus short lifespan of these transmitters. As a result, the chances of detecting any Columbia River chinook on the southeast Alaska line are nil (which was confirmed when the SE Alaska line was finally recovered in late November when a weather window opened up). According to the figures below which are based on actual data from 3 fish detected at Brooks Peninsula, the minimum battery life for any transmitter used in Columbia River fish that are

Fig. 1. Calculated location of the tagged Snake River chinook smolts, based on the measured speed of the detected smolts. Note that these animals very quickly left the Columbia River region and moved up the coast, but that the tags are projected to have died by Day 30, still to the south of the Brooks Peninsula line.

intended to be detected by a POST acoustic array in SE Alaska should be no less than ~100 days. This translates into a transmitter with a 1 minute pulse interval-- which is the POST code map which we have already designed.

Conclusions

In summary, measured rates of movement for the 4 tagged Snake River chinook smolts are quite rapid, but suggest that because of the short tag life resulting from the transmission schedule chosen in 2004, virtually all of the tags ceased functioning before reaching the operational Brooks Peninsula line. (All three tags detected at Brooks Peninsula were beyond the manufacturer's predicted operational lifespan at the time of detection).

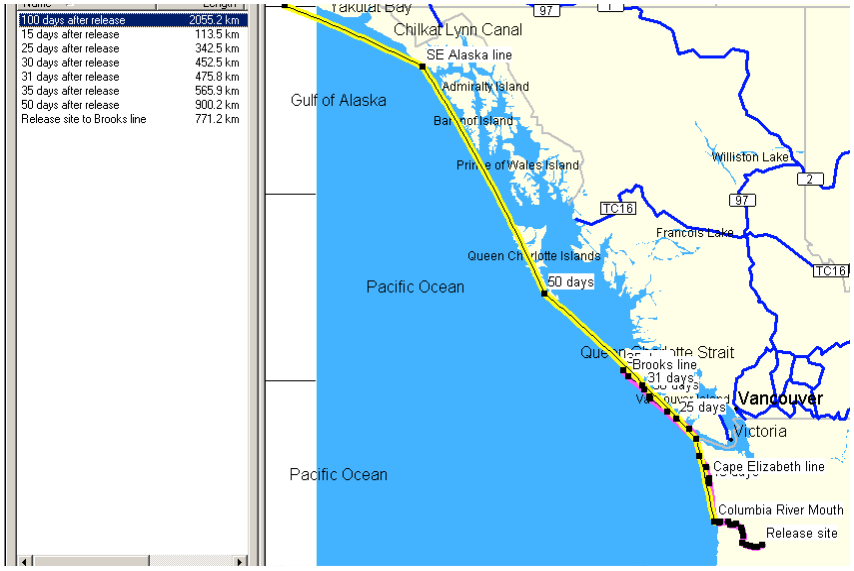


Fig. 2. Calculated location of tagged smolts moving along the coast at various times post-release, based on the measured speed of the Snake River smolts detected in 2004. The smolts are projected to be able to reach the Alaskan line by Day 100, given the observed rates of travel. Using the full POST-code map designed by Kintama Research, we can achieve a tag life of 4.5 months (ca. 135 days) which should be ample to track Snake River chinook to the SE Alaska line.

As the redeployment of the Grays Harbor line on 3 July was successful, with all but the nearest unit to shore recovered on 1 September 2004, the mechanical problems appear to be largely corrected. It must be emphasized, however, that the shelf along the West Coast of Oregon and Washington is an extremely challenging environment to work in. The ideal location for deploying acoustic lines are in rocky regions with deep water to near shore, since these regions allow us to place near-shore units in relatively deep water where they are not subject to large wave-induced movement. The seabed off Oregon and Washington is exposed to offshore storms, consists largely of sand, and the shelf is shallow for long distances offshore. As a result, acoustic units are subject to strong wave action and may potentially be buried by sand dunes migrating along the seabed.

The performance on the array for British Columbia salmon smolts tagged with the POST code map and for green sturgeon demonstrates that the array can work well under the appropriate circumstances. Data on Columbia River salmon collected in 2004 is too limited to provide firm conclusions, but does indicate that tagged Snake River chinook smolts move rapidly away from the Columbia river and plume region at about 23 kms/day relatively near-shore. The lack of any detections on the Grays Harbor line after redeployment in early July suggests that Snake River smolts did not remain off the Washington state coast.

The detailed data on the 2004 performance of the array on British Columbia salmon smolts, where Kintama Research had complete control over the code map used in the tag programming, is reported in Appendices A&B. We anticipate that the same performance standard can be achieved for Columbia River smolts in the ocean if the code map for these smolts is changed to a 60 second transmission interval.

Appendix A.

Pacific Ocean Shelf Tracking Project

David Welch, Chief Scientist
Kintama Research

Progress Report 31 August 2004

Summary

Last month I wrote to say that the results from the first year of the demonstration phase indicated that we have a major scientific success-- if current instrument recovery rates continued. Since that time we completed the recovery of all acoustic lines, downloaded the data, and re-deployed each acoustic line again[1]. Although there has been some loss of equipment, we have had a complete recovery of all instruments deployed on the northern Strait of Georgia & Queen Charlotte acoustic lines, and high rates of equipment recovery from all other listening lines.

The results from the first recovery indicate that all of the tagged salmon smolts subsequently detected moved through the river and marine array very quickly, largely leaving the system by mid-June. At this time we have just completed the second (and final) recovery of the Juan de Fuca acoustic listening line, which indicates that there were no further detections of tagged smolts through the Strait of Juan de Fuca since the first recovery. As of 9 September, I have received word that the final recovery of the 9 western-most receivers on the northern Strait of Georgia line had detected the presence of 1 Cheakamus coho, approximately one week prior to recovery. As almost all the tags used this year would reach the end of their battery life-span by the end of September, this single coho provides the first evidence for coho still surviving within the Strait of Georgia ecosystem.

In contrast to the other species (see below) there have been very few movements of tagged coho over the Strait of Georgia lines (excluding Howe Sound). The extremely poor survival of Thompson (Coldwater) River coho and chinook is particularly notable, as almost none of which survived to leave the Fraser River (See Table 1). This result contrasts with the results for other stocks, which indicates in-river survival is generally quite high (a result which includes the Coldwater steelhead—indicating that the results for coho and chinook do not generalise to all stocks within the Fraser River).

Our general results contradict long-held assumptions that (1) freshwater habitat disruption was a major contributor to the poor stock status of Pacific salmon stocks, and (2) that the challenges associated with adjusting to the salt-water environment soon after leaving the rivers plays a major role in determining the abundance of salmon stocks. The results from this year's tracking array allow us to extend this conclusion to encompass an entire large marine ecosystem—the Strait of Georgia. What we are seeing is that (with the exception of Strait of Georgia coho) there is no one area that has exceptionally poor survival. Rather, the results indicate that mortality

[1] Except Alaska—we will recover this line once at the end of September

occurs throughout the freshwater and marine system, and there is a steady attrition in numbers wherever we have measured it.

The biological details are described below. The major point that I will make here is that the scientific credibility of the marine tracking array has now been proven. Although we still need to complete a more detailed statistical analysis of the results, probably the most important point I can make here is a technical one—we have shown that the array concept can be used to provide an almost complete census of tagged animals as small as 12-14 cm salmon smolts as they cross a single acoustic listening line stretching more than 20 kms in length. This technical result is extremely important, because it has never before been possible to achieve this type of measurement. The implication is that the development of a permanent marine array will confer an ability to precisely measure movements and survival of salmon (and other fish) all along the west coast of North America. This ability will revolutionise marine science.

I will mention in passing one more point of interest. I set up the Vemco fish tracking receivers this spring so that one spare channel was used to detect fish tagged with "non-POST" tags. We now have a bonanza of unanticipated data for green sturgeon, the rarest and least well-known of the 26 species of sturgeon found around the world. (Only three spawning populations are known to date, all in the USA: the Sacramento and Klamath rivers in California, and the Rogue River in Oregon). Of approximately 175 green sturgeon tagged in the US, we have detected 42 different animals (or about 25% of the total), giving a wealth of detailed data showing both movement between lines and evidence for long-term residence near the Brooks Peninsula line (off NW Vancouver Island, in Canada-- not the USA). Surprisingly, we have only detected animals from the Klamath and Rogue Rivers, supporting some recently published conjecture that the Sacramento green sturgeon have different marine pathways. However, the key point here from the POST perspective is that even the limited array we have put out this year has provided an exceptional amount of data on these enigmatic fish, and demonstrates the much broader utility of the array than to addressing solely salmon issues.

As a memory aid, we have included a map of the tracking array, with abbreviations for each acoustic listening line indicated. Summary details on survival for each stock are compared on the table that follows, and a detailed stock by stock summary follows at the end of this report.

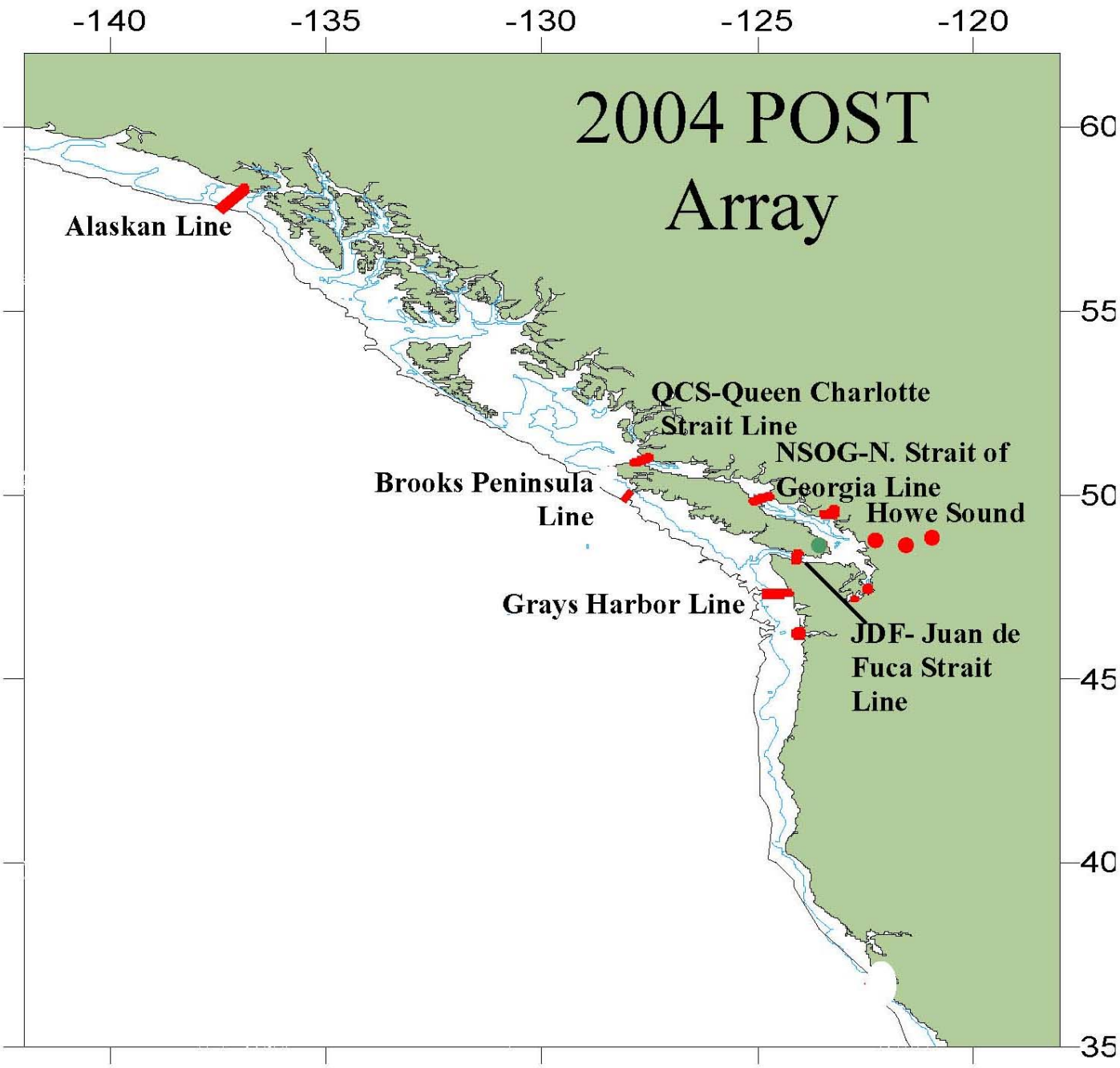

2004 POST Array
-140
-135
-130
-125
-120
60
55
50
45
40
35
Alaskan Line
QCS-Queen Charlotte Strait Line
NSOG-N. Strait of Georgia Line
Brooks Peninsula Line
Howe Sound
Grays Harbor Line
JDF- Juan de Fuca Strait Line

Table 1. Summary of POST salmon smolt survival rates. Numbers are listed in the text.

Species & Stock	*% surviving fresh water*	*% surviving to leave Strait of Georgia*	*% of freshwater survivors that also survived to leave Strait of Georgia*[2]
Coho			
Cheakamus	45	0	0
Coldwater (Thompson R)	3	0	0
Nimpkish	79	9	12
Qualicum	n/a	0	0
Keogh	98[3]	36[4]	36
Steelhead			
Cheakamus	75	27	37
Coldwater (Thompson R)	52	19	38
Englishman	79	15	19
Keogh (Wild)	77[*]	31	40
Keogh (Hatchery)	71[*]	29	42
Chinook			
Coldwater- Hatchery	4	0	0
Coldwater- Wild	(5)	0	0
Sockeye[6]			
Cultus Lake	61	13	21
Sakinaw Lake	n/a	18	n/a

[2] *Defined here as detection on either the Juan de Fuca or Queen Charlotte Strait acoustic lines.*
[3] *Receivers were placed only a few hundred metres from Keogh tagging site. A significant fraction (~10%) of Keogh steelhead are believed to have residualised (remained in freshwater and not left for the ocean).*
[4] *Keogh River steelhead and coho (& Nimpkish coho) have only been detected leaving the Strait of Georgia ecosystem via the Queen Charlotte Strait line to the north; no fish have been detected moving south through Johnstone Strait to the inner Strait of Georgia.*
[5] *The total number of putative wild chinook smolts tagged was either 2 or 4 (hatchery fish were released part way through the tagging of the wild fish, and wild fish can not be distinguished in the river). The one chinook detected leaving the Fraser River was definitely of wild origin, because it was tagged prior to the hatchery release. As a result, wild fish survival was either 25% or 50%, but is obviously based on very small numbers.*
[6] *Significant fractions of Sakinaw and Cultus Lake sockeye were also detected moving widely within the Strait of Georgia, including excursions into Howe Sound. These results will be reported in the detailed write-ups that will follow. This behaviour was not seen in any other tagged groups.*

Table 2. Detections of Green sturgeon by the POST array. Results below show the number of separate detections of each tag by area, up to 21 August 2004. More recent data (which includes 10 additional new sturgeon and 10 sturgeon that were re-detected are not included.

Tag Code	Species	Tagging Site	Fish Tag Owner	Brooks Peninsula (NVI)	Grays Harbor	Juan de Fuca Strait	Howe Sound Inner	Howe Sound Outer A	Howe Sound Outer B	Northern Strait of Georgia	Queen Charlotte Strait
100	Green sturgeon				126						
519	Green sturgeon			43							
1025	Green sturgeon			102							
1030	Green sturgeon			560	15						
1034	Green sturgeon					198					
1036	Green sturgeon				55						
1045	Green sturgeon			360	55						
1050	Green sturgeon				1						
1051	Green sturgeon				2						
1052	Green sturgeon			2857							
1053	Green sturgeon			18							
1055	Green sturgeon		5	20							
1057	Green sturgeon			928							
1060	Green sturgeon			139							
1064	Green sturgeon				1						
1067	Green sturgeon		3344	138							
1082	Green sturgeon		2								
1094	Green sturgeon		35								
1096	Green sturgeon		126								
1097	Green sturgeon		7927		12						
1108	Green sturgeon			38							
1109	Green sturgeon		1341	112							
1110	Green sturgeon		1540								
1112	Green sturgeon		3								
1114	Green sturgeon		110								
1118	Green sturgeon		325								
1119	Green sturgeon		530								
1121	Green sturgeon			118							
1124	Green sturgeon		4								
1125	Green sturgeon			25							
1127	Green sturgeon			40							
1129	Green sturgeon			119							
2033	?									21	34

Cheakamus Coho (Squamish River)

5 fish were heard on the NSOG line (one of which wasn't heard on the outer Howe Sound lines), and 0 were detected on the QCS line. This means that 25 (not 24) of the 36 ocean-detected fish were detected past the inner line of Howe Sound. So, at least 25% of the original tagged fish, or 56% of those leaving the river mouth survived to leave Howe Sound. 5% of the original fish, or 11% of the fish that left the river mouth survived to the NSOG (assuming these fish all headed north). Again, assuming they are not resident somewhere to the south, 0% survived to QCS line.

Cheakamus Steelhead (Squamish River)

25 fish were heard on the NSOG line, and 10 on the QCS line (1 of which was not first detected on the NSOG line). An additional 4 steelhead were detected on the Juan de Fuca line. So, of the 51 fish tagged, 59% survived at least as far as the JDF and NSOG lines (and of those leaving the river mouth 79% survived to those lines). 37% of fish entering the ocean survived to leave the Strait of Georgia system (27% of the original tagged fish). One Cheakamus steelhead that was heard leaving via the Strait of Juan de Fuca was also heard at the Englishman River mouth.

Coldwater fish (Thompson River watershed)
Only 3 coho survived to the lower Fraser array, and one chinook. Steelhead survival in contrast was much better. None of the 4 coho and chinook detected in the Fraser River were detected elsewhere. Given that the lowest river receiver was still some distance from the river mouth (45 kms), freshwater mortality could be as high as 100%, although in the table below we have assumed freshwater survival if detected on the river receivers. Of the 16 steelhead detected in the Fraser River, 5 survived to JDF and 1 to the QCS line (this steelhead was also heard on NSOG line). So, 19% of the fish tagged survived to leave the SOG system, or 38% of those surviving freshwater survived to leave the SOG system.

Cultus Lake Sockeye
59 of the 100 tagged fish were detected in the Fraser River, and a further 2 were detected on the NSOG line that were not heard in the river, so freshwater survival was 61%. None were detected in JDF, suggesting that the migration route is solely to the north. 13 fish were detected on the QCS line, so 13% of the originally tagged sockeye survived to leave the SOG system, or 21% of the freshwater survivors. All sockeye were released at Cultus Lake, although they were reared (and tagged) at the Rosewall hatchery.

Englishman Steelhead
53 of the 67 tagged fish were detected, 35 of them at river mouth. (It was recognised that the receivers placed in the ocean off the Englishman river mouth were unlikely to provide complete accounting of fish reaching the ocean, because of the geography of the region). Many of the fish made it to the NSOG line (38) but only 10 were heard on the QCS line. River detections were not complete with 18 fish detected on the NSOG or QCS Strait line that had not first been detected in the river (2 of the 10 QCS fish had not previously been detected, neither in the river or on the NSOG line suggesting incomplete censusing).

Keogh Coho

Almost all of the tagged coho (98%) were detected in the river, unsurprising since the release site was only a few hundred metres from the ocean. Some may be false detections owing to the large number of simultaneous fish at the receivers (several false detections of other stocks occurred) however, with no evidence to discard them we have included them in the counts. No fish went as far south as the NSOG line and 36% (38 fish) were detected leaving the SOG on the QCS line. The conditions leading to some false detections at the Keogh River mouth were unique and will be discussed in a more detailed report later.

Keogh River Dolly Varden
These fish have so far only been detected at the mouth of the Keogh. 6 out of 8 adults and 17 out of 30 juveniles have been heard.

Keogh Steelhead
Of the 92 hatchery fish that were transported from O'Connor Lake, 65 were detected at the river mouth and/or QCS. It is estimated that about 10% of the steelhead residualised and presumably went back upriver when the fence was removed. 60 of the 78 tagged wild fish were detected at the river mouth. In both cases more of the steelhead disappeared than can be accounted for by residualisation, which is in contrast to the coho where almost all the tagged fish were detected at the river mouth. Explanations include: steelhead moving very fast and so several went undetected because of the large number of tagged fish in the area, several of the supposed coho detections are actually 'false' detections (several other stocks were supposedly detected at the Keogh river mouth) or, mortalities of the steelhead were higher. None of the hatchery or wild steelhead were detected on the NSOG line, implying that they all moved north. (A final judgement cannot be made on this point until the NSOG line is retrieved a second time in September). 27 of the 65 hatchery fish were detected on the QCS line and 24 of the 60 wild fish.

Nimpkish Coho
Survival down the river was high (79%) but detections on the QCS line were low – only 9 fish. This included one of the early-release fish that could not be detected in the river mouth because it was released before the river receivers went in. 4 fish were detected at the Keogh river mouth, and the number of detections in 2 cases are very large, hence we can be confident that these are real. No fish were detected moving south.

Qualicum Coho
Numbers are very low, of the 97 fish tagged only 1 made the NSOG line and none were detected leaving the SOG system.

Sakinaw Lake Sockeye
These fish were the widest spread of any stock. The fish were released directly into the ocean, near the river mouth, and hence no freshwater survival data is available. Of the 97 fish tagged, 41 were detected in total: 3 in Howe Sound, 36 on the NSOG line, 16 on the QCS line and 1 on the JdF line. There was also a Sakinaw sockeye detected up the Fraser River (multiple detections of a single tag) but a Sakinaw tag inside a predator remains the most likely explanation.

Appendix B.

Pacific Ocean Shelf Tracking Project

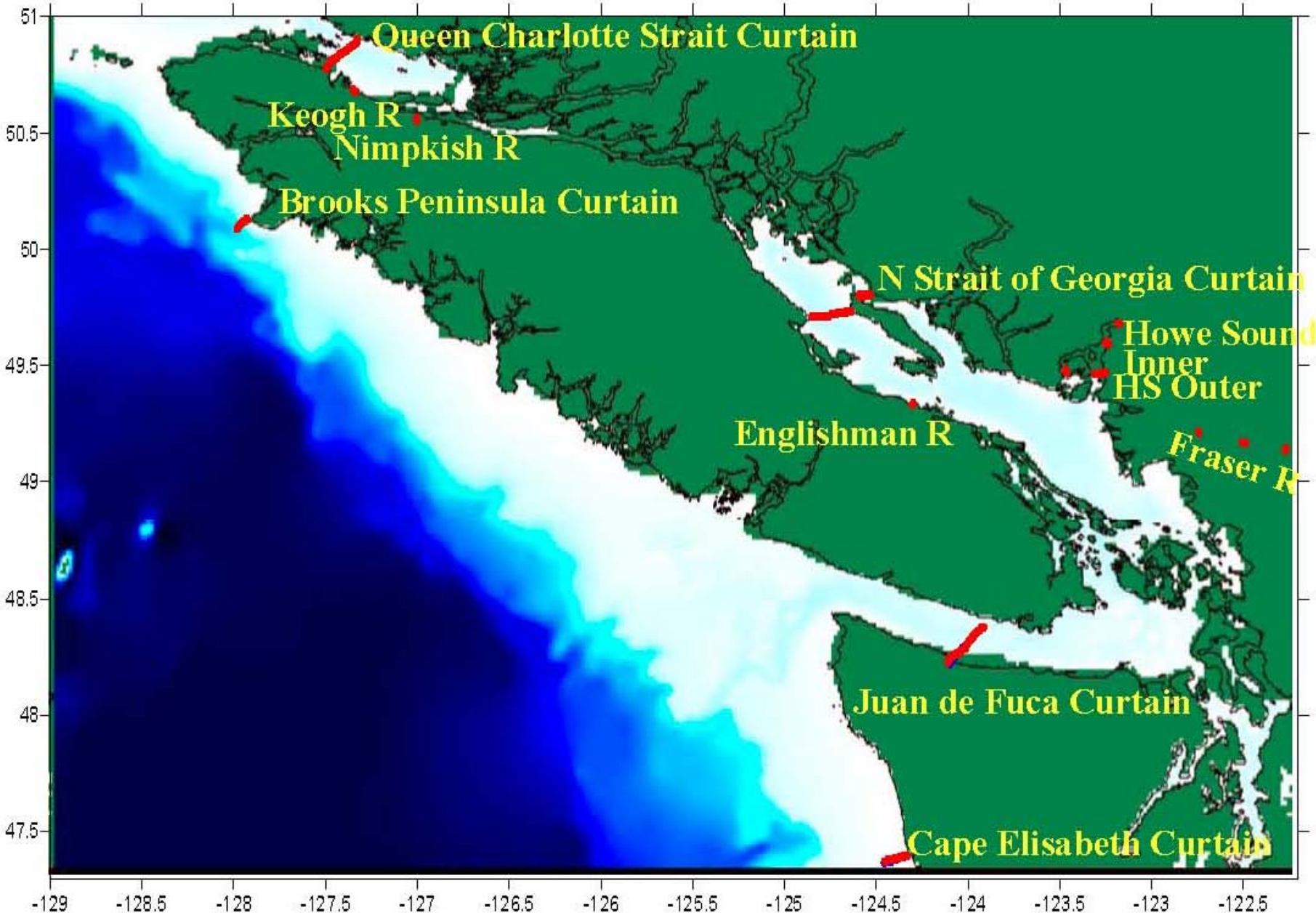
David Welch, Chief Scientist
Kintama Research

Progress Report 4 October 2004

Summary

Since writing last month's report, we only have a few new items to report:

- All equipment from the lines surrounding Vancouver Island were completely retrieved (Brooks Peninsula, Queen Charlotte Strait, northern Strait of Georgia).
- As a result, the only equipment losses after the second deployment (mid-July) were the 3 nodes closest to land on each side of the Strait of Juan de Fuca and the single node closest to shore on the Cape Elisabeth (Grays Harbor) line. The modified deployment approach is clearly working, although our continued reliance on a groundline connecting the nodes is probably now a liability in shallower waters where trawlers are working. This groundline was essential to the recovery operation this year because of a number of problems with the acoustic releases that were ordered this year.
- The president of the company who manufactures the acoustic releases flew up from California and went out to sea with me for 3 days in Juan de Fuca Strait to assess the problems himself. We both recognise and agree on some of the causes, and have agreed on a path to addressing most of them. One important question that remains unresolved is premature battery depletion in some (but not all) units. These are priority issues for resolution over the winter months prior to the 2005 field season.
- We have been on stand-by for the weather to clear in Alaska for almost 3 weeks. We are waiting to fly up to Sitka (Baranof Island) and retrieve the final acoustic line (deployed at Cape Spencer, north of the Alaska panhandle). Captain Davis reports today that a 58' seiner sank last night in the storm just outside Sitka, so I am pleased to continue waiting. When we do fly up to Alaska, we will spend some time laying the groundwork for next year's expanded effort.
- The recovery of the Queen Charlotte Strait line reveals that 3 Nimpkish and 1 Keogh River coho were finally present in August and early September. (None of these stocks have been reported on any of the lines to the south or on the Brooks Peninsula line to the west). This result demonstrates some coho did survive to the end of the field season, but the very few fish detected does not allow us to determine when the majority of the coho migrate out of the Strait of Georgia or what the actual survival has been. This is a big difference from the sockeye and steelhead results.
- The Senior Scientific steering committee met in late September to review the science work completed, and most members stayed to participate in salmon and sturgeon working group meetings that followed immediately thereafter. These deliberations will be reported at the Management Board meeting in October.
- A table summarising updated detections is appended to this report.


Queen Charlotte Strait Curtain
Keogh R
Nimpkish R
Brooks Peninsula Curtain
N Strait of Georgia Curtain
Howe Sound
Inner
HS Outer
Englishman R
Fraser R
Juan de Fuca Curtain
Cape Elisabeth Curtain
51
50.5
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47.5
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